

832-6

NOV 14 1934

HOW TO CURE CONCRETE

*A Manual of Instruction on the
Curing of Concrete*



THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

Branch Sales Offices: 60 East 42nd Street, New York City
Second and Madison Streets, Saint Louis



Copyright 1933 - The Dow Chemical Company, Midland, Michigan

FOREWORD

This manual is published to provide important facts selected from reports of the Highway Research Board, The U. S. Bureau of Public Roads, various state highway departments, and other reliable sources.

We have collected definite and reliable information and have put it in brief form as a safe, handy guide to concrete curing practice.

We also have for distribution two other manuals of interest to highway officials and workers:

How to Maintain Roads.

How to Control Dust.

Either may be had by writing The Dow Chemical Company or its branch offices.



CURING CONCRETE PAVEMENTS

“Proper curing of concrete is the setting up of favorable conditions for chemical action during the early hardening period” (Report of Highway Research Board Curing Committee). In setting up these favorable conditions the presence of sufficient moisture to insure complete hydration of the cement is important. The use of calcium chloride, either applied on the surface, or incorporated in the mix, provides this moisture and insures maximum strength concrete.

The study by the Highway Research Board Curing Committee of the results of investigations conducted by many States and the Bureau of Public Roads, as well as the condition of thousands of miles of calcium chloride cured concrete pavements has proven that the use of calcium chloride surface, or integral curing, provides maximum strength and durability uniformly throughout the pavement slab at a maximum of time and at a reasonable cost.

The more scientific testing is done, the more results point to the use of Dowflake calcium chloride as meeting all requirements for durable concrete, controlled action and cost, for early pavement use and quick release of costly equipment.

An Added Control Factor—An Added Safeguard

Dowflake calcium chloride provides needed control comparable to that which now governs the ingredients and proportions of the mix, because its analysis is exact, its reactions can be accurately planned in comparison with dirt and water methods taken as standard.

Conceded as satisfactory and rated as standard, dirt and water still offer variables. In contrast calcium chloride gives more exact control—is an added safeguard.

Who, for instance, knows the exact thickness and weight of earth? Does every square yard of dirt-cure have the same thickness? Or the same amount of water? Or any water? Is inspection possible, thorough, and constant?

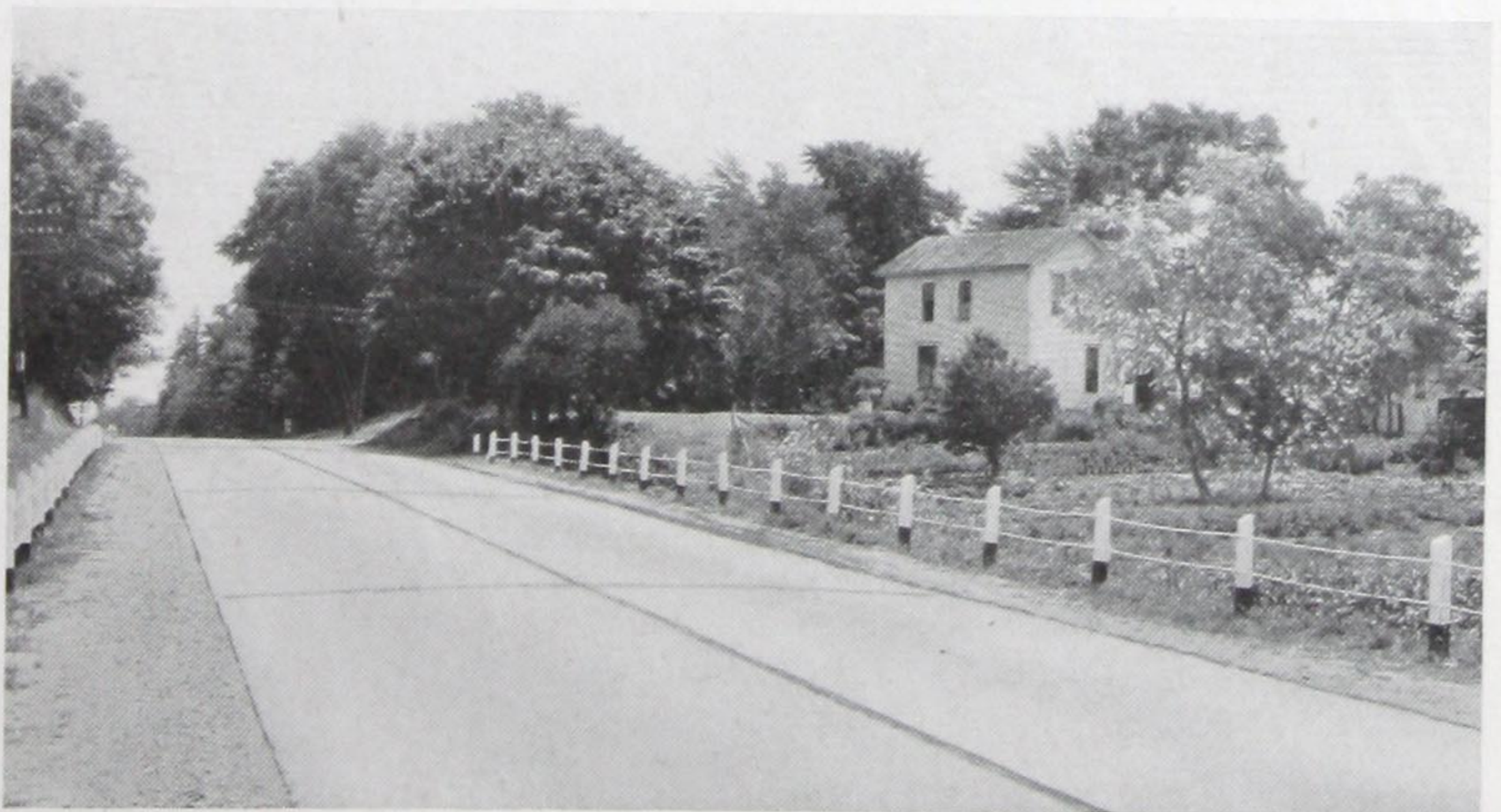
If, with all these uncertainties, dirt and water is standard, then is it not a fact that a material of known action, performing the same functions with less labor and less liability of losing moisture, will be the accepted method everywhere?

Calcium chloride is the favored method for its exactness, for its automatic control. Calcium chloride gives a positive cure. Once applied, it does its work whether continually inspected or not. The cost of transporting sufficient calcium chloride to cure a mile of slab is but a fraction of the cost of providing dirt and water for the same slab.

If analysis of cement and proportions of mix are vital, is it not essential then to have a curing factor as dependable and as automatic?

We have, as advantages of calcium chloride over other forms of curing:

1. Controlled automatic chemical action as exact as the chemical action of tested cement.
2. Saving most of the cost of getting curing materials to the job—and all cost of removing them.
3. Acceleration of curing action where time is a factor.
4. Additional cold weather protection when normal precautions are observed.



Concrete curing with Dowflake is automatic, accurate and fast

ADVANTAGES TO CONTRACTORS AND OFFICIALS

Showing a slab of improved properties would, of course, be sufficient reason for the use of Dowflake calcium chloride as a curing agent. Yet if there were no advantages to the slab except merely a maintenance of standard values, calcium chloride would still be a boon to contractors and officials.

Saves Hauling and Disposing of Dirt

There are places, of course, where dirt, water and straw are right at hand in quantities, so that curing costs may be no higher than with calcium chloride. But there is a question even in such cases if the cost of providing, hauling and disposing of dirt and straw is not actually greater. Where dirt is not available nearby but must be hauled long distances, the balance in favor of calcium chloride can mean the difference between profit and loss.

Saves on Pipe Line, Pump Erection and Maintenance

Dowflake calcium chloride provides its own moisture on being applied direct to the pavement surface after wet burlap has been removed. In case of concrete brought from central plants, the use of Dowflake frequently eliminates the need for setting up pump and water pipe lines. This saving in itself is sizeable, particularly where curing water must be pumped long distances.

Releases Equipment and Man Power

Instead of maintaining a crew of men in partial idleness to wait for removal of forms, to putter about in keeping water on the dirt covering, the contractor can release equipment and laborers in a much shorter time. The high early strength of Dowflake-cured slab permits quicker removal of forms for use on new work—avoids tying up unnecessary investment in forms, and releases both men and equipment to speed progress on other work, since one man can handle all the curing with calcium chloride.

Saves on Water Supply

Water is frequently scarce. With Dowflake calcium chloride curing there's no need to rob the mixer or stop forward work to use water for curing. Dowflake calcium chloride provides its own moisture. Every engineer and every paving contractor should make sure to have a supply of Dowflake on hand even when curing with dirt and water. There is a critical time in curing when the moisture supply must be constant. Pumps may break down and wells go dry, yet the pavement need not be ruined for lack of curing when Dowflake is available. The cost of erecting and maintaining pumps and pipe lines, added to the cost of earth hauling and removing, plus labor of wetting the dirt continually, if added together will show Dowflake to be as economical as it is fast, sure and safe.



Dowflake saves heavy expense, especially where earth and water are hard to get

Reduces Curing Labor

By either surface application or as an admixture, curing with Dowflake is a part time, one man job as contrasted with the many men necessary for dirt and water or straw and water cure. The decision of "How to Cure" should take into consideration the investment and wear and tear on trucks to handle earth, the labor costs, the shovels and equipment, the supervision, the inspection and the hundred and one other items that are involved with dirt and water or straw and water curing. Contrast this with wheeling a simple spreader over the pavement once and you will readily understand why the Dowflake method gains favor so rapidly.

Makes Inspection Simple and Certain

Instead of the busy job of watching men spread sufficient earth, instead of watching to see that the covering is uniform and is properly wetted and kept wet, all the inspector has to do is to see that the calcium chloride is applied to the surface when the wet burlap is removed. No further inspection is necessary. One reliable man can assure proper application and positive curing by the surface application method. When used as admixture, the curing operation is assured when the concrete is poured. It is automatic and certain.

Why Curing with Calcium Chloride is Approved by the U. S. Bureau of Public Roads

The Highway Research Board and the U. S. Bureau of Public Roads have done much constructive work in establishing comparative values and merits of various curing processes. Laboratory tests have been exhaustive. Extensive mileage in various states has been cured with calcium chloride and constantly checked with other curing processes. The committee reports that calcium chloride surface curing (1) does not create volume changes that cause checking, (2) does not cause scaling, (3) attains strengths equivalent to the wetted earth method. Calcium chloride surface treatment is the only method other than wetted dirt which has passed all conditions set forth by the Highway Research Board as necessary for the

proper curing of concrete. These safeguards plus the high early and permanent strengths derived, fix calcium chloride finally and definitely as a superior curing material. This means that a contractor gains full approval as well as great advantage by using Dowflake calcium chloride.

Advantages to the Public

Long time detours are as disappointing to the public as they are costly to the contractor. One cannot always have or build a paved detour. When heavy traffic is diverted for unnecessary periods of time, it causes traffic problems that continually annoy highway officials because of their annoyance to the public. Heavy loads shift. Trucks become mired or break down and hold up traffic. High early strength from calcium chloride curing permits shortening the detour period and is, therefore, a public benefit as well as a trouble saver for both official and contractor.

Possibly the public has been spoiled and has learned to expect too much. So frequently roads are broken up, graded, paved, cured and turned back to traffic so rapidly that the public no longer dreads a detour as it did some years back. It has learned that modern engineering has taken the annoyance out of highway improvement. Nothing aids more in speeding up paving operations than rapid curing with calcium chloride. Nothing adds more to the profit from a paving operation than its quick completion and opening. It is an advantage to the public as well as to official or contractor.

TWO TESTED METHODS

Calcium chloride curing may be accomplished either by the surface application or the admixture method. Both have strong supporters. Probably varying conditions make one method preferable over the other in certain instances. But in all cases where used as specified, the cure is positive, automatic, safe and dependable by either method. Furthermore, there is no discoloration of the pavement where calcium chloride is used.

Both uses of calcium chloride, either when applied on the surface of the concrete or when incorporated in the mix, have been proven excellent methods of curing through the study conducted by the Highway Research Board and both methods are approved for use by the U. S. Bureau of Public Roads.

The application of calcium chloride on the surface always provides proper curing; the use of calcium chloride in the mix not only insures proper curing, but is of particular advantage when early strength concrete is desired, due to its ability to accelerate the setting of the cement.

The matter of selecting the proper curing method thus becomes a matter of choosing between the surface or admixture method, according to the convenience of the supervising official. Either one is a superior curing method. Both are of special value in cold weather.



SURFACE CURING

Curing of a concrete slab by spreading Dowflake calcium chloride on the surface is a simple operation. Immediately after the wetted burlap has been removed and the pavement will carry the weight of the spreader without detrimental effect to the surface, you simply put on a uniform coating of calcium chloride with a hand spreader, using not to exceed 2 pounds per square yard.

If thought desirable, the surface of the pavement may be broomed or squeegeed as soon as the calcium chloride has gone into solution. In this way the calcium chloride solution is uniformly and thoroughly distributed over the entire surface of the slab. Under no circumstances does curing with Dowflake cause any discoloration of the slab.

It was recognized in the early days of surface curing with Dowflake that it kept the surface wet and performed its curing by retaining sufficient moisture to prevent premature drying out. It was thought at the time that retaining this surface moisture did the whole job. Later study proves, however, that while it retains sufficient moisture to complete the hydration of the cement, it also penetrates several inches into the pavement and has a favorable action in speeding up and completing the cure.

Since the government tests are conclusive and since the surface method is approved by the U. S. Bureau of Public Roads, the surface treatment has gained popularity. Probably its greatest advantage to the paver lies in the fact that it is a one man job that leaves visible evidence for accurate and rapid inspection. It takes away half the curing troubles and annoyances. It is fast, safe and certain.

SURFACE APPLICATION OF DOWFLAKE CALCIUM CHLORIDE *

After the concrete has been properly finished according to specifications of the contract, it should be protected against rapid drying by covering with burlap thoroughly wetted as soon as, in the judgment of the engineer, the concrete has sufficiently set to prevent marring the surface. The burlap should be kept continuously wet by sprinkling during the day as required.

As soon as practicable after the concrete has taken its final set, usually on the day following the day of pouring of the concrete, all burlap should be removed and the pavement cured by means of dry flaked calcium chloride applied to the surface.

The surface should be covered with flake calcium chloride, applied at the rate of not to exceed two (2) pounds per square yard spread by means of a squeegee or suitable mechanical spreader so that uniform distribution is obtained. Satisfactory application cannot be obtained by spreading with shovels and brooms. Should there be any lumps, these should be broken or removed from the surface of the pavement.

The calcium chloride should not be applied during a rainfall. If it should rain within a period of two (2) hours following the application, an additional quantity equal to the amount lost should be applied.

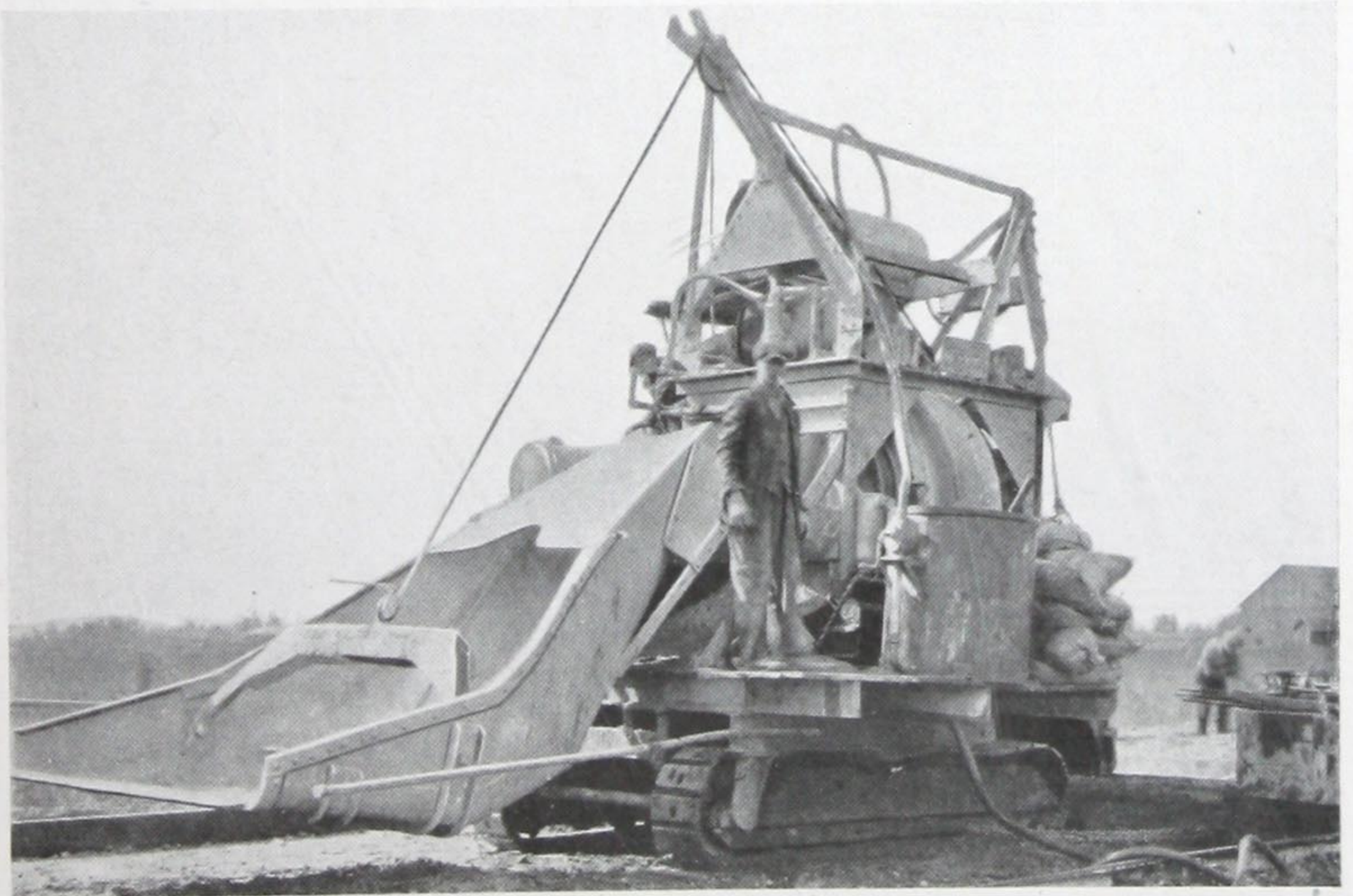
*These recommendations are based on A. S. T. M. Designation: C 83-31 T



ADMIXTURE CURING

A solution of Dowflake calcium chloride added to the mix means that when you mix the cement and pour the slab you include the curing agent at the same time. This curing, so far as the contractor is concerned, is performed and inspected while mixing, leaving no curing trouble for later consideration.

Becoming a part of the gauging solution, the curing ingredient permeates the entire slab, curing uniformly from top to bottom. It accelerates the set, gives high early and permanent strengths. It lessens the time needed for protection against cold, and lessens also the time forms must be kept in use. It works while men and equipment are employed elsewhere.



The curing begins as soon as the slab is poured. Exhaustive tests show such gratifying results that many engineers consider this method equal to any form of curing. It is entirely automatic and simple.

The admixture method cures thoroughly, without discoloration. The surface is smooth and long wearing, the slab a satisfaction to contractor and official alike.

ADMIXTURE APPLICATION AND APPARATUS *

Where used as an admixture, Dowflake calcium chloride should always be incorporated in the form of a solution. It is simply dissolved in a part of the gauging water. The amount of Dowflake required for admixture use is determined on the basis of cement used. This percentage varies from $1\frac{1}{2}\%$ to 4% by weight of cement, according to climatic conditions.

Admixture Apparatus

There are many simple forms of mixing apparatus and methods of preparing solutions. A very simple, yet a satisfactory alternate method of preparing the solution is to use two 60 gallon barrels or drums mounted on a small platform built on the side of the mixer. First place about 35 gallons of water in the barrel and then pour in two 100-pound sacks of Dowflake. Mix this thoroughly so that all of the Dowflake is dissolved, then fill the barrel with water to the 50 gallon mark. From this barrel take as many gallons of solution as is necessary to give the proper percentage. As an example, one gallon will contain four pounds of Dowflake. Another barrel may be used for mixing the solution while using the first barrel. This always gives an additional supply of 50 gallons, so that there is no holding up of the mix in order to have the Dowflake solution ready.

Many pavers today carry admixture apparatus as standard equipment. If your mixers are not thus equipped, you can obtain the apparatus from the manufacturer or it can be made from blueprints which we will furnish. It consists of tanks for mixing the proper solution together with a means of introducing the correct amount of solution into each batch along with the water. Specifications for admixture curing will be found on page 16 and following pages of this book.

Method of Introducing Solution into the Mix

A positive approved method shall be used for adding the calcium chloride solution to the mix. Any method used shall

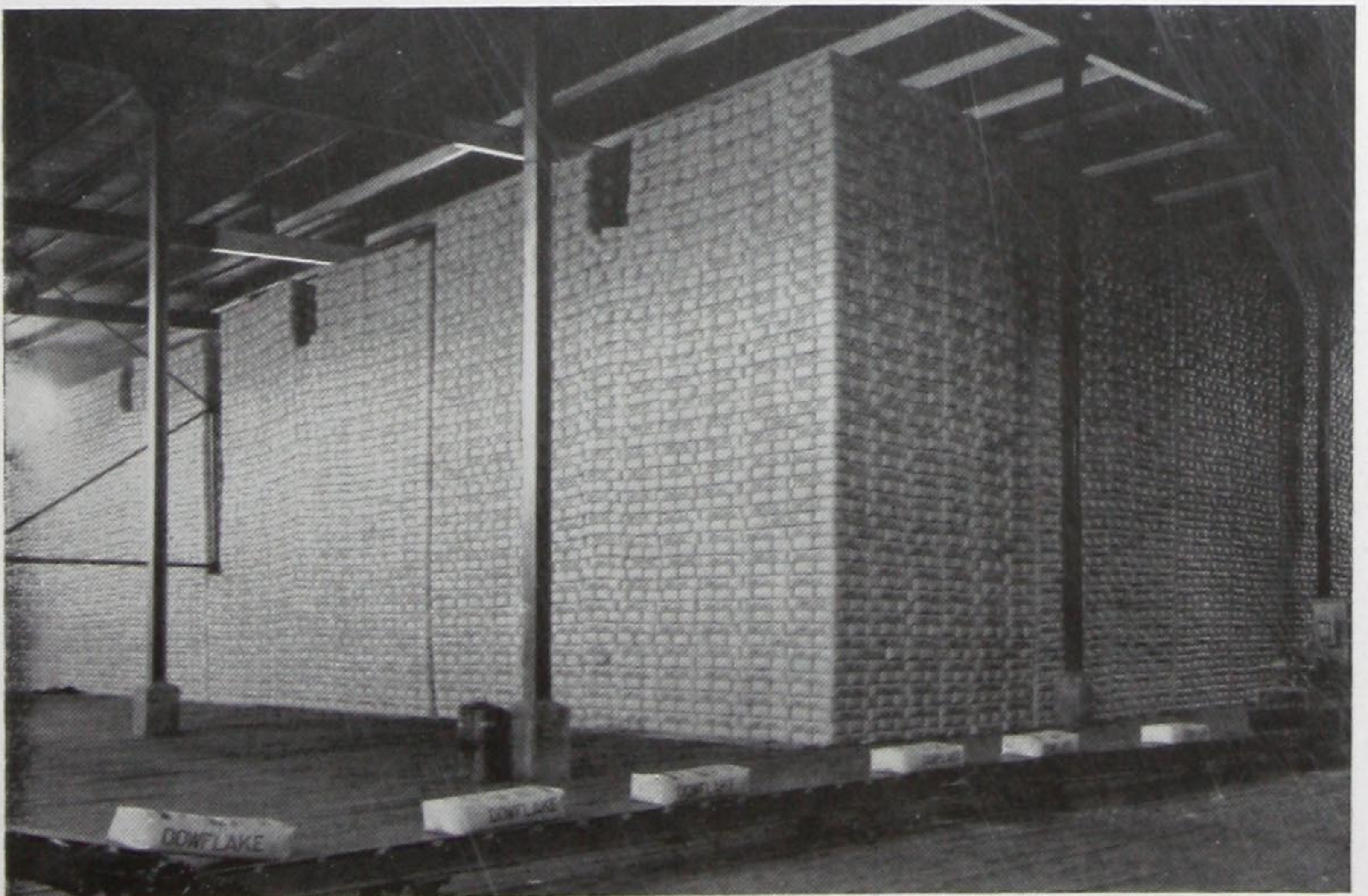
*These recommendations are based on A. S. T. M. Designation: C 82-31 T

be subject to the approval of the engineer. The amount of gauging water shall be corrected to allow for the amount of calcium chloride solution added.

Amount. The amount of calcium chloride required shall be on the basis of percentage by weight according to the amount of Portland cement used. The table below will give the percentage recommended for various climatic conditions, considering at the same time the typical local cements used. It is not necessary that absolute accuracy be maintained; for example, for the American size bag of cement two per cent may be figured on the basis of two pounds per bag. However, on account of the difference between the Canadian and the American bag, the columns below will refer to percentages.

Temperatures averaging about 70° F.	1½%
Temperatures averaging between 70° and 40° F.	2%
Temperatures averaging between 40° and 30° F.	3%
Temperatures below 30° F.	4%

Under no circumstances should more than 4% be used.



RECOMMENDATIONS AND SPECIFICATIONS FOR ADMIXTURE CURING

It has been our privilege to collect from the recommendations of government, state and other officials, and from interested engineers, the data from which to recommend process and materials for admixture curing. Since admixture curing has come to be such an important part of concrete work, we have felt it advisable to codify the various recommendations with the aim of establishing standards of practice, materials, properties and tests and to standardize also methods of patching, inspection, conditions under which materials should be used, amounts to use, time and method of application, and also the definite properties materials must meet. We are, therefore, giving the following information based on proper recommendations.

These recommendations will be maintained up to date each year as "How to Cure Concrete" is published. As time proves new factors to be efficient practice they will be incorporated in these recommendations. Our sources of information are some of the foremost experts of the country and their findings carry with them a degree of accuracy which may be relied upon by the most exacting engineers.

The recommendations in this volume can be used safely in the specification work of state highway departments, county and municipal engineers, as well as any other technical men working on concrete specifications. For several years the specifications which we have carried in "How to Cure Concrete" have been used by many engineers throughout the country and we shall continue to preserve their authentic value in each edition of "How to Cure Concrete". We, therefore, invite comment upon them at all times and will be more than pleased to receive the result of thorough-going laboratory and field tests.

MATERIAL SPECIFICATIONS

1. *Material Covered.* This specification covers calcium chloride to be used for road purposes, acceleration of concrete, and curing of concrete.

2. *Physical Properties.* The calcium chloride shall be in the form of loose, dry flakes, and when tested by means of laboratory screens and sieves shall meet the following requirements:

Passing $\frac{3}{8}$ inch screen	100%
Retained on $\frac{1}{4}$ inch screen . . .	Not more than 20%
Passing 20 mesh sieve	Not more than 10%

3. *Chemical Composition.* The chemical composition shall conform to the following requirements:

CaCl_2 (anhydrous)	Not less than 77.0%
MgCl_2	Not more than 0.5%
NaCl	Not more than 2.0%
Other impurities	Not more than 1.0%

Note—Dowflake more than meets the above A. S. T. M. specifications.

Packages

4. *Packages.* The calcium chloride shall be delivered in moisture-resisting bags or sacks containing 100 pounds each, or in drums. The name of the manufacturer, the batch number, and the percentage of calcium chloride guaranteed by the manufacturer shall be plainly marked on each container.

Inspection

5. The manufacturer shall take and retain representative sealed samples from carload lots and hold the same for a period of twelve months subject to demand by the purchaser. Every facility shall be provided the purchaser should he elect to have his own representative sample the material at the plant. If the purchaser decides to sample the material after delivery in the field, it is understood that a 3 per cent variation in content of CaCl_2 from the chemical composition stated in paragraph 3 shall be permissible, but this shall not in any way relieve the manufacturer if the sealed sample taken at the time of manufacture does not show in analysis at least 77 per cent CaCl_2 .

6. *Rejection.* Calcium chloride shall be rejected if it fails to pass any of these specifications and if it cakes or becomes hardened in the containers.

GENERAL INFORMATION ON DOWFLAKE CURING

Corrosion

Since calcium chloride is a salt, many engineers are of the opinion that corrosion of reinforcing steel may result when this material is added to a concrete mix. However, the steel is not subjected to the effects of calcium chloride in its salt state, but to a mass of concrete in which has been included a minute amount (.003 of the mass) of a salt that has been neutralized by the cement, which is a strong alkaline material. If the reinforcing is properly embedded in the concrete it will be impossible for corrosion to occur under any conditions.

Among the researches reported as to the corrosion of reinforced steel are those of J. C. Pearson, former physicist of the U. S. Bureau of Standards. This investigation revealed that corrosion was absent over the greater portion of the surface of the rods, what rust occurred being localized apparently where voids occurred on the surface of the steel. It was also noted that the corrosion as indicated by the one year and five year specimens was not progressive. (A. S. T. M. Vol. 23, Part II, page 327).

In a discussion presented before the American Society for Testing Materials, H. S. Mattimore of the Pennsylvania Highway Department stated, that upon examination of calcium chloride admixture concrete reinforced with cold drawn wire mesh there was no evidence as to corrosion of the wire mesh. This examination has covered a period of ten years.

Volume Changes

Volume changes of concrete occurring during the setting of the cement and due to temperature and moisture changes affect definitely the service to be derived from a concrete structure. If the stresses set up during these changes exceed the strength of the concrete, excessive cracking will result. Volume changes may be due to a number of factors, but one of the most important is the loss of moisture during the setting period. Calcium chloride, either applied on the surface or incorporated in the mix, controls the moisture loss so that volume changes are reduced to a minimum and cracking is prevented.

Does Not Cause Scaling

During 1929 a survey of the surface condition of approximately two thousand (2,000) miles of concrete pavements was conducted by the Curing Committee of the Highway Research Board. Of this mileage approximately 1,250 miles was cured by the surface application of calcium chloride and 600 with the dirt and water method. This survey covered the states of Wisconsin, Minnesota, Illinois, Missouri, and Rhode Island. The following conclusions as to this survey were drawn by the Committee:

(a) Calcium chloride surface application used as a curing method under normal conditions is not a primary cause of scaling.

(b) If conditions conducive to scaling are present the scale will probably occur to some extent under either earth and water or calcium chloride surface method of curing.

(c) Insofar as calcium chloride surface curing is concerned, scaling is not an important factor.

Workability

The results of years of practical experience with Dowflake as an admixture for concrete mixes have definitely indicated that there is a decided increase in workability. In many cases contractors have been more enthusiastic over what they call the lubricated mix than they have over the other features of Dowflake, since workability is a great factor in the rapid completion of concrete construction or paving work. Dowflake has been recommended by many of the contractors who have found it unnecessary to use any other fattening mixture in order to maintain the progress with the minimum amount of labor that they desired.



PATCHING CONCRETE PAVEMENTS

Patching operations on concrete roads are quite often necessary because of conditions which cannot always be controlled. No matter how careful a contractor may be, sagging of sub-grade will occur from drainage or unsubstantial fills. Upon occasions, frost action in water pockets and other causes will break the pavement, and in other cases severe overloading and heavy traffic have freak actions upon parts of the pavement. While the amount of patching necessary is being lessened in almost every new pavement, it is a factor which must have consideration. If it must be done at all, it should be done well.

When patching operations are necessary two important factors must be considered. The broken section must be completely removed and the slab broken back to a point where sub-grade and slab are again perfect. Preparing the pavement for patching requires the use of a suitable machine for breaking out the concrete. When the hole is cleaned out, it should be filled with concrete to which an admixture of Dowflake has been added. It will then obtain sufficient strength to permit early use.

Many territories require the admixture of Dowflake in concrete used for patching work, even though they do not always cure their slab with Dowflake. The reasons for this are that a pavement is rarely closed for patching. Barriers are set up to close off part of the road and there is a considerable expense and a great deal of trouble involved in maintaining barriers and danger lanterns and signals.

Admixture curing for patch work has another great advantage in that the Dowflake, through its property to absorb and hold moisture, gives a much better bond to the old parts of the pavement and the patch is not likely to break away as with the ordinary mix.

DOWFLAKE FOR COLD WEATHER CONSTRUCTION

The difficulties of cold weather construction have been a challenge to engineers and contractors alike. Solving cold weather problems has brought to light a wealth of improvements in concrete construction. Among them, the use of calcium chloride in cold weather concreting stands out as a safeguard not to be neglected.

Use calcium chloride in all cold weather concrete work. Do not expect it to take the place of other necessary factors. It will not make a satisfactory concrete from frozen aggregates—nor ice water. The soundest rules for winter work involve these essentials: 1—Aggregates and water must be warmed to 70° F. or above, though not too hot. 2—They must be kept warm until satisfactory strength is secured. 3—Sufficient moisture must be retained or supplied to continue the chemical action. 4—Low water ratios and richer mixes give greater early strength.

Dowflake calcium chloride, through hundreds of critical tests, has shown marked properties for aiding all these four factors essential to cold weather work.

High Early Strength

Of first importance is the acceleration of the chemical action. Dowflake speeds up the setting of cements and the attaining of high early strengths. Such concrete has attained safe strengths in 30% to 60% less time. In dangerously cold weather or exposed locations, the sooner the concrete is safe the less danger from sudden and excessive cold and storm.

Secondly, once a warm mix is placed, chemical action itself supplies part of the necessary warmth to complete a cure. Dowflake aids this chemical action, causing it to arrive at a given strength in about half the time.

Dowflake aids also in retaining sufficient moisture for continued chemical action, preventing to an extent too early drying out.

Use Dowflake in all winter work but use it wisely, not as a substitute for heated aggregates—not as a substitute for

continued warmth and moisture—not as a substitute for tarpaulin or canvas protection—but as an aid to all these, which will, along with such intelligent protection, give you safe concrete in half the time. It puts concrete out of danger in a very short time when rightly used. How important this is will be readily understood from the statement in the concrete engineers hand book where it is said that concrete at 40° requires four times as long a period to obtain a given strength as the same concrete at 50° and ten times as long at 40° as at 70° .

Concrete making is a chemical action which requires warmth and moisture. Dowflake is, we firmly believe, a necessary element, a safeguard in all cold weather work.

Experiments have shown that from two to four per cent of Dowflake can be used to decided advantage, depending upon the temperature.



MISCELLANEOUS INFORMATION

Table for Converting Cubic Yard Weight to Tons

In view of the fact that all shipments and most purchases of coarse and fine aggregates are based on the ton weight, the following conversion table worked up by Mr. Theo. A. Polansky, C. E., Parkersburg, W. Va., should prove of general service.

Table Showing Cubic Yard Weights in Pounds in
Ton Weight Equivalents

Weight of aggregates in pounds per cubic yard	Equivalent weight in tons	Fractional number of cubic yds. per ton	Weight of aggregates in pounds per cubic yard	Equivalent weight in tons	Fractional number of cubic yds. per ton
2,100	1.050	0.952	2,600	1.300	0.769
2,150	1.075	0.930	2,650	1.325	0.754
2,200	1.100	0.909	2,700	1.350	0.740
2,250	1.125	0.888	2,750	1.375	0.727
2,300	1.150	0.869	2,800	1.400	0.714
2,350	1.175	0.851	2,850	1.425	0.701
2,400	1.200	0.833	2,900	1.450	0.689
2,450	1.225	0.816	2,950	1.475	0.677
2,500	1.250	0.800	3,000	1.500	0.666
2,550	1.275	0.784			

Weight of a Cubic Foot of Substance

	Pounds		Pounds
Asphaltum	87	Gravel	90-106
Brick, Best Pressed	150	Ice	60
Brick, Common Hard	125	Iron, Cast	450
Brick, Soft Inferior	100	Lead	711
Cement, Portland	100	Lime, Loose	53
Clay, in Lump, Loose	63	Limestone	168
Coal, Bituminous, Solid ...	84	Sand, Loose	90-106
Coal, Bituminous, Broken..	49	Shale	162
Earth, Loam, Dry, Loose ..	76	Sandstone	151
Earth, Loam, Moderately		Water	62 $\frac{1}{3}$
Rammed	95		

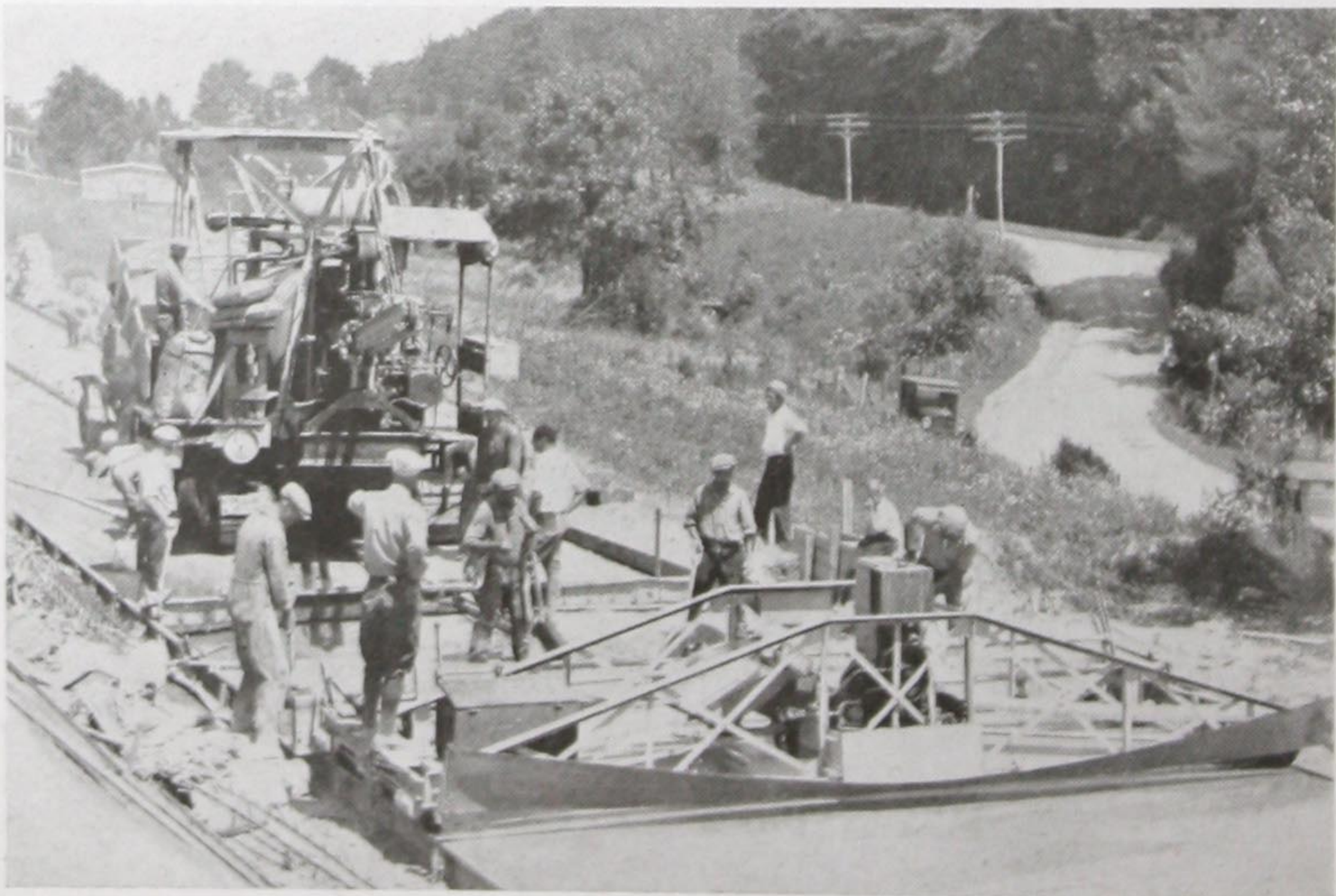
Square Yards Per Mile

Width of road in feet	Sq. yds. per lineal foot	Sq. yds. per mile	Width of road in feet	Sq. yds. per lineal foot	Sq. yds. per mile
10	1.1	5866	24	2.6	14080
12	1.3	7040	28	3.1	16427
14	1.5	8213	30	3.3	17600
16	1.7	9387	32	3.5	18773
18	2.0	10560	36	4.0	21120
20	2.2	11733	40	4.4	23466

DOWFLAKE SHOULD ALWAYS BE KEPT ON HAND

Dowflake has so many uses that it ought to be on hand wherever road materials are stored. Its use as a dust-proofing agent has brought about safer driving conditions on thousands of miles of gravel roads—has permitted residents along these roads to enjoy summer weather free from the annoying, unhealthy dust cloud. It has made hundreds of communities cleaner, better places in which to live—has brought more business to the merchants of those communities. And it has made the road man's job easier by permitting him to give moist, firm, dust-free, easily maintained roads at no extra cost to the taxpayer.

By saving money in concrete curing, keeping roads open to traffic in summer and winter, preventing all kinds of material from freezing, Dowflake gives a service that makes its use almost indispensable to leading highway officials. You will find Dowflake included in road construction budgets in many states and communities. You should use it in your locality.



FOR THAWING MANHOLES, SEWERS, HYDRANTS, CULVERTS, ETC.

Dowflake is a very useful article to have on hand in winter to prevent frozen hydrants, manholes, sewers, culverts, etc. Fire hydrants in which the drip valves are plugged, and which stand in low, wet ground are likely to become frozen in cold weather. A small quantity of Dowflake in solution form will, except in the most severe weather, keep the hydrant in working order throughout the winter.

For frozen catch basins Dowflake is simply poured directly from the bag into the grating or manhole. Within a few minutes the catch basin will have become sufficiently clear of ice to permit surface water to move.

For Keeping All Kinds of Material from Freezing

The low freezing point of calcium chloride, plus its ease of application and handling, makes its use valuable as a safeguard against the freezing of various types of construction materials, such as sand, gravel, etc. No matter what your cold weather construction or storage problem, investigate Dowflake—it may prove the deterrent against freezing you are looking for.



THE FIRM BEHIND THE MANUFACTURE OF DOWFLAKE CALCIUM CHLORIDE

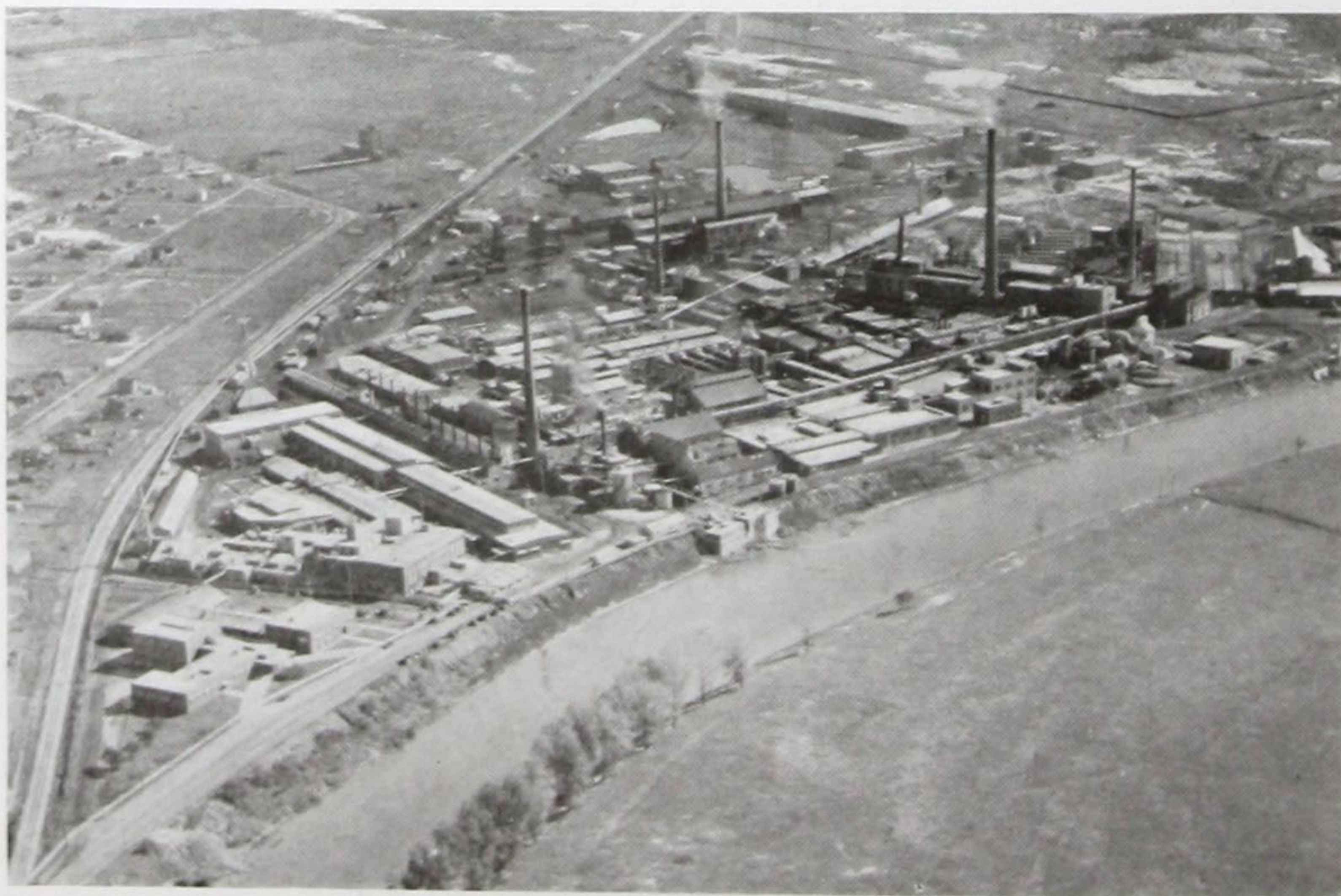
Dowflake is manufactured in one of the largest and most modern chemical plants in the world. All of the resources, experience and knowledge of this vast organization where over 200 chemical products are manufactured are behind the production of Dowflake. Thousands of tons of this material are produced each year. And each year sees wider distribution.

The present Dow plant illustrated below covers over 230 acres and employs 2500 men. There are 310 buildings and 18 miles of standard gauge railway tracks within the plant.

Steady, uninterrupted production, plus extreme care in manufacturing methods, makes Dowflake calcium chloride a dependable, high quality, effective dust prevention and concrete curing agent.

THE DOW CHEMICAL COMPANY MIDLAND, MICHIGAN

Branch Sales Offices
60 East 42nd Street, New York City
Second and Madison Streets, Saint Louis





A properly cured pavement

